SiPM

EIC eRD110 Meeting - 9th September 2021

Silicon Photomultipliers

Pros:

Magnetic field insensitive

Fast evolving technology

Cost-effective, suitable for mass production

Robust, low bias voltage

Cons:

High dark count
→ high rate, precise timing readout

Limited radiation tolerance
→ layout, packaging
→ cooling, annealing

R&D depends on detector and location
Less demanding: calorimetry + dRICH
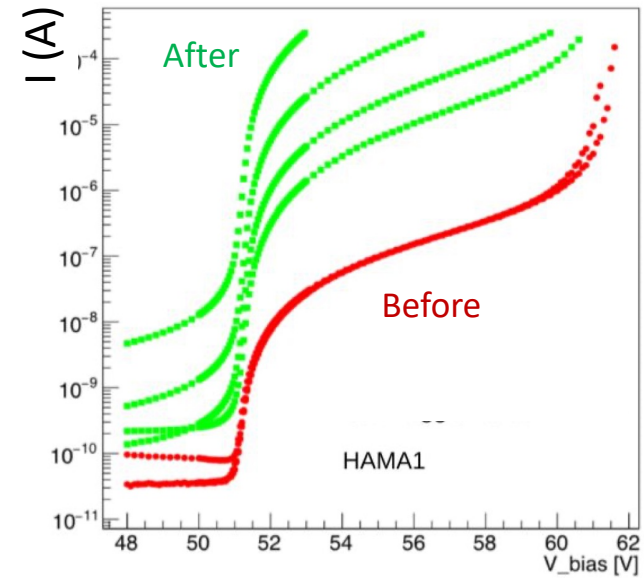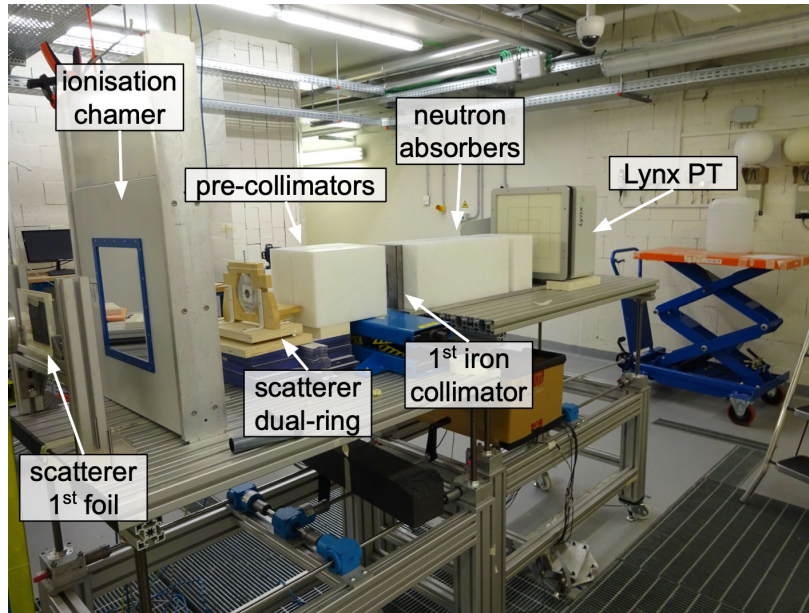
<u>Custom</u> matrices with commercial SiPM standards

HAMA2   HAMA1

<u>Custom</u> matrices with new SiPM developments

FBK
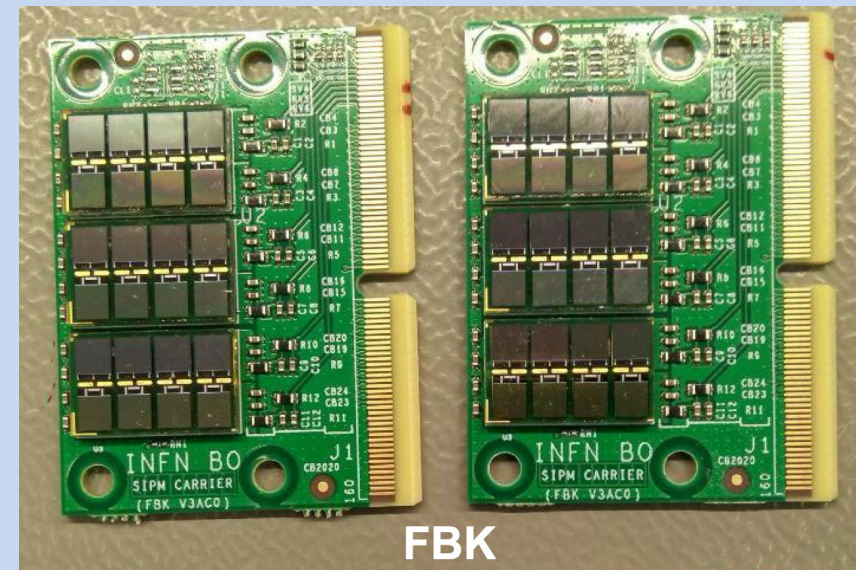
SiPM Irradiation

TIFPA
Proton
Beam
Facility
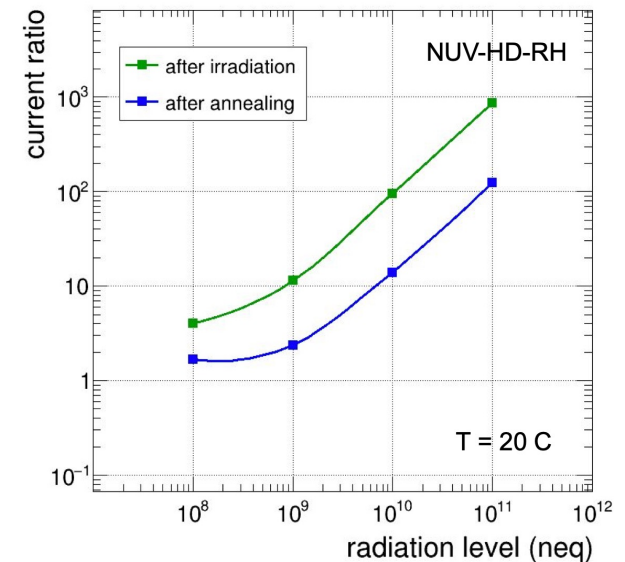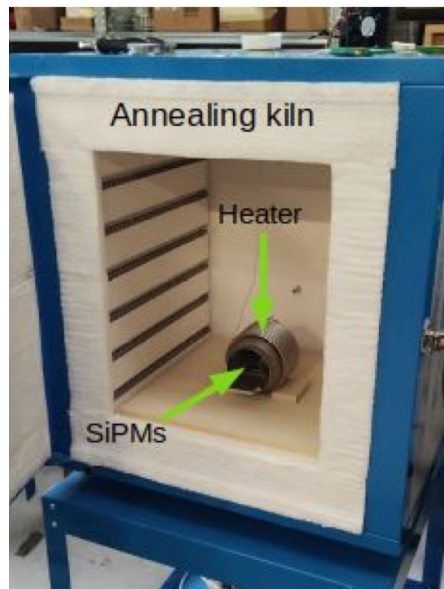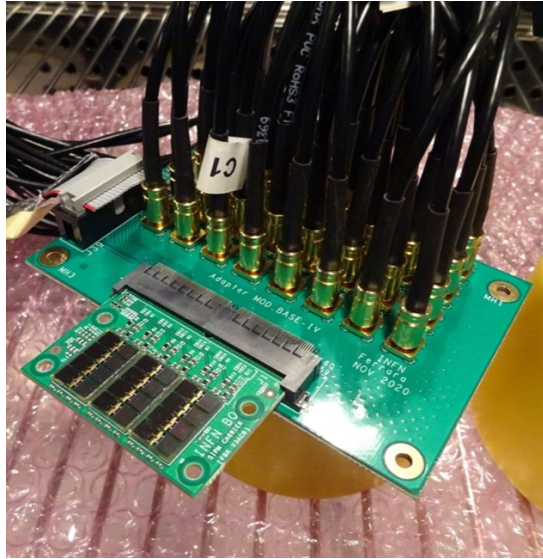

Collimated
Beam
10^9-10^{11} n_{eq}

INFN
Laboratory
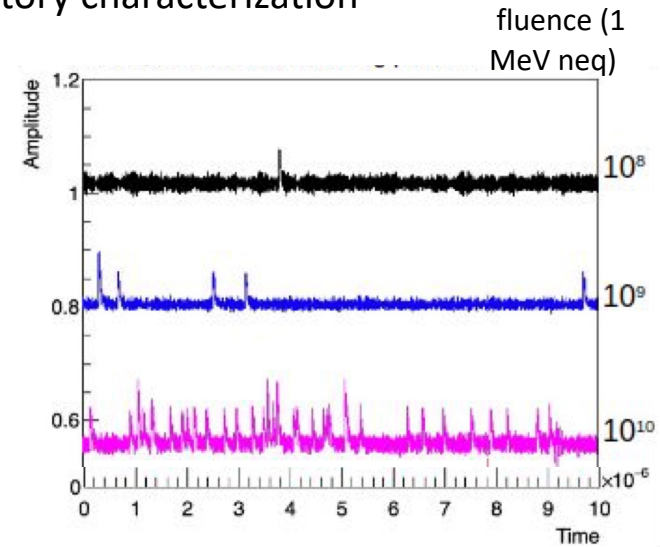Infrastructure

Annealing
up to 180 C

Cooling
down to -30 C

Characterization

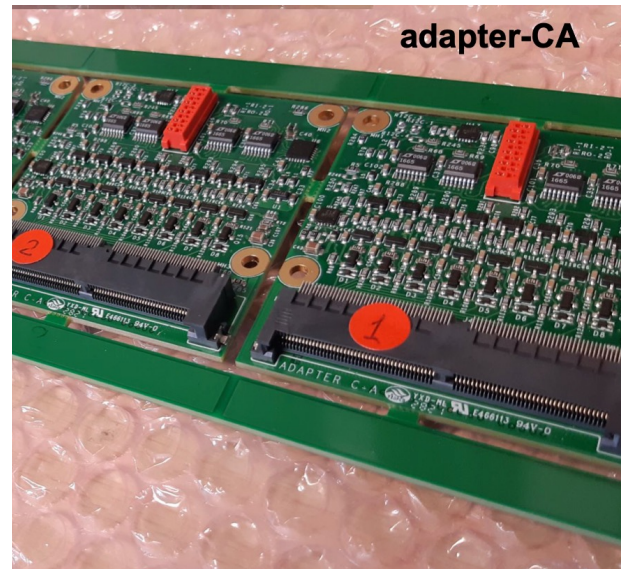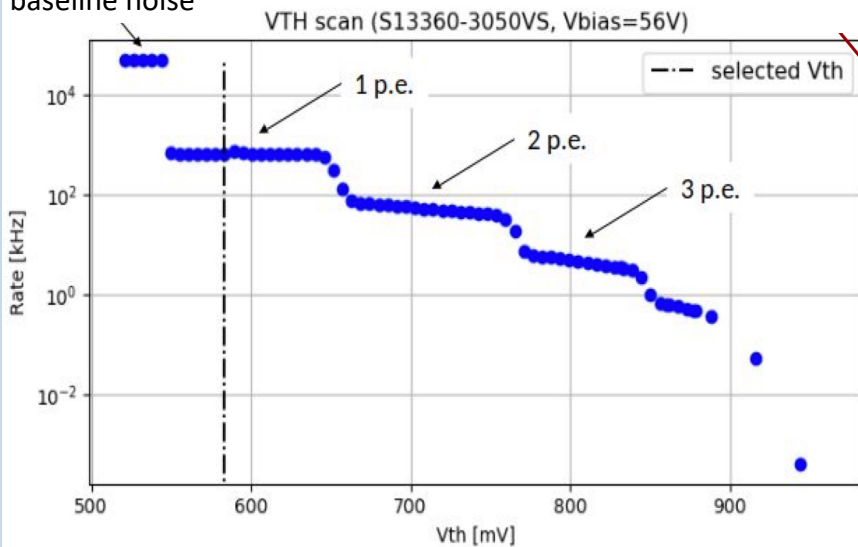## Custom electronics for laboratory characterization

fluence (1 MeV neq)
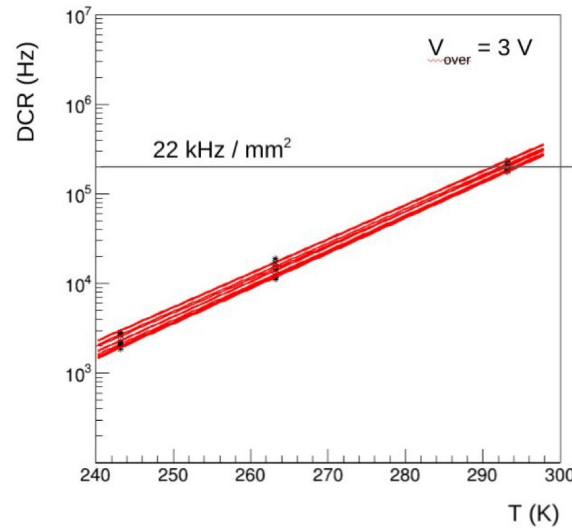
ALCOR-based readout to characterize SiPM + study readout specs (preamp, discr, ToT, digitization, throughput, …)

baseline noise

VTH scan (S13360-3050VS, Vbias=56V)

- · - selected Vth

1 p.e.

2 p.e.

3 p.e.

adapter-CA

FY22 Targeted R&D

Complete tests on commercially available sensors
Start custom development with manufacturers (for temperature treatment)

Milestones:

Comparative assessment performance after $10^{11}/cm^2$ 1 MeV neq dose*
Annealing protocol*

* for commercially available sensors

Funding profile:

Commercial SiPM + service electronics	10 k$
Custom developments with manufacturers	20 k$
Co-funded personnel	30 k$

Note: expected similar costs in FY23/24

INFN in-kind contribution: TIFPA irradiation facility, laboratories and infrastructures (including CERN test beams), experienced personnel (part-time), dedicated personnel (co-funded).

SiPM Program

Demonstrate that a proper choice of the SiPM layout, temperature treatment, and precise timing readout, could mitigate the technological risk on photo-sensors at EIC.

FY22: Assess baseline performance for PID detectors

FY23-24: Extend the R&D to calorimetry

 Define specs and optimize sensor layout with manufacturers

Realize a basic SiPM readout unit for Cherenkov applications with integrated cooling and signal formation (synergy with electronics development)